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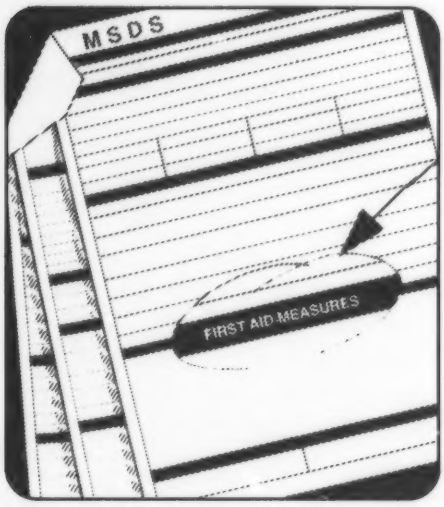

THE MATERIAL SAFETY DATA SHEET

A Practical Guide to First Aid

P91-4E

by
Jessie M Callaghan,
Donald M Cooper

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1. INTRODUCTION

The purpose of first aid is to minimize injury and disability. In serious cases, first aid is necessary to sustain life. The First Aid Measures section on a Material Safety Data Sheet (MSDS) provides recommendations on how to minimize the effects of an accidental exposure to a chemical product. The recommendations should describe measures which first aiders can safely use at the scene of the accident before obtaining medical assistance.

First aid information on an MSDS is one component used to establish an effective first aid program for the workplace. The people responsible for this program must ensure that:

- the necessary emergency equipment and facilities are available at the worksite, and
- everyone working with the product is trained and equipped to administer the appropriate first aid.

The purpose of this publication is to present a system for preparing and evaluating first aid recommendations for chemical exposures in the workplace. This publication is meant to be used by people who have a basic understanding of chemicals and their effects. It is not intended to provide specific advice on how to respond to the effects of particular chemicals. It is not a first aid training manual. Rather, it is meant to be used by people who write or evaluate first aid recommendations for Material Safety Data Sheets.

This document first describes a basic approach to preparing the first aid section of an MSDS. It then discusses the reasoning behind the specific recommendations. Finally, a step-by-step system for selecting the appropriate recommendations for each route of exposure is presented.

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2. A BASIC APPROACH TO FIRST AID FOR THE MSDS

This section examines what can be assumed and what overriding factors must be considered when determining first aid recommendations for an MSDS. The premises stated in this section were used to develop the specific recommendations and the step- by-step system presented in this publication.

THE MSDS CAN ASSUME THAT THE PERSON WHO PROVIDES FIRST AID TO THE VICTIM HAS BASIC FIRST AID TRAINING. Therefore, MSDSs do not need to recommend or explain how to execute procedures followed in every emergency. For example, trained first aiders know they should initially check airways, bleeding and consciousness.

GENERALLY, THE MSDS CAN ASSUME THAT MEDICAL ASSISTANCE CAN BE OBTAINED WITHIN A REASONABLY SHORT PERIOD OF TIME (THAT IS, 60 MINUTES). If medical assistance is not readily available, the recommendations should be reviewed by a person familiar with the product and the facilities available in that particular environment.

THE MSDS SHOULD PROVIDE INSTRUCTIONS WHICH DIRECT THE FIRST AIDER TO RESPOND TO THE SPECIFIC HEALTH EFFECTS OF THE PRODUCT. Any procedures recommended in the First Aid Measures section must correspond to health effects described in the Toxicological Properties/Health Hazard Data section of the MSDS. The MSDS should not introduce any new health effects in the First Aid Measures section. Furthermore, the MSDS should not describe first aid procedures which are not applicable to the product.

THE MSDS SHOULD NOT EXCLUSIVELY DESCRIBE FIRST AID RECOMMENDATIONS WRITTEN FOR THE "WORST CASE" EXPOSURE. Usually, first aid is given for mild to moderate exposures. If the MSDS places too much emphasis on extreme exposures, the first aid procedures may be overstated. Sometimes, inappropriate first aid could harm a victim, for example, inappropriate oxygen administration. The best approach is to write first aid procedures for situations most likely to occur based upon knowledge of the product's use and its properties.

IN GENERAL, THE MSDS SHOULD KEEP RECOMMENDATIONS SIMPLE AND ADVISE THE USE OF MATERIALS WHICH ARE READILY AVAILABLE IN MOST WORKPLACES. For example, usually first aiders should use water to remove a chemical from the eye rather than saline (a neutral salt solution). This is because water is effective and searching for the saline could waste valuable time.

THE MSDS SHOULD NOT RECOMMEND PROCEDURES WHICH MAY COMPLICATE SUBSEQUENT MEDICAL CARE UNLESS THE BENEFITS OF THE PROCEDURE OUTWEIGH THE RISK. For example, the use of special creams or ointments must be carefully considered. This is because the cream or ointment may have to be removed before a medical professional can assess the injury and begin treatment. In addition, removal of the cream or ointment could worsen the injury (18). Nevertheless, in some cases the benefits do outweigh any risks. For example, there is strong evidence that certain ointments are very beneficial in the first aid treatment of hydrofluoric acid burns (27).

NORMALLY, THE MSDS SHOULD NOT INCLUDE PROCEDURES WHICH FALL OUTSIDE THE DEFINITION OF FIRST AID. It is sometimes difficult to determine where first aid stops and medical intervention starts. However, first aid normally does not include invasive procedures, such as intravenous or oral medications. The MSDS can recommend more complicated techniques or medical acts, such as oxygen administration, under certain circumstances. There are two criteria for including these procedures:

1. The intervention must be essential to sustain life or prevent other serious consequences. As well, the intervention must not introduce significant new risks. In other words, the benefits of the procedure must outweigh any risks associated with it.

2. It must be legally acceptable for the first aider to perform the intervention. This can be determined by contacting local first aid authorities or the governing College of Physicians and Surgeons. It will be necessary to obtain special training and delegation of authority from a doctor.

THE FIRST AID MEASURES SECTION SHOULD NOT CONTAIN INFORMATION DIRECTED TOWARD MEDICAL PROFESSIONALS. This is because inclusion of this information could be confusing to the first aider. The MSDS could direct comments to medical professionals in the Additional Information section under a heading such as "Notes to Medical Personnel". For example, statements such as "monitor kidney function" or "perform gastric lavage" are useful to doctors, not first aiders.

Writers and reviewers of first aid recommendations may find the following basic outline

useful. An MSDS should:

- Provide recommendations for each potential route of occupational exposure.
- Present recommendations in the order in which first aiders are to carry them out.
- Specify any special protective equipment or procedures necessary to protect the first aider, if applicable.
- Advise interrupting the source of exposure, either by removing the source from the victim or the victim from the source.
- Recommend well-established first aid procedures, if applicable.
- Recommend specific medical interventions, if appropriate.
- Describe the need and urgency for medical follow-up.

3. A BACKGROUND DISCUSSION OF THE RECOMMENDATIONS

This section discusses issues which affect the choice of recommendations used in this document. This background discussion addresses topics such as the use of oxygen and whether or not to induce vomiting for chemical exposures. Appendix 3 explains the reasons for wording of recommendations where specific wording has particular significance and is not self-explanatory.

3.1 The Use Of Oxygen

The use of oxygen has commonly been recommended as a first aid procedure for any inhalation exposure. Presumably this practice was adopted because oxygen was thought to be helpful in any case where the victim became short of breath or unconscious. Administering oxygen may have been perceived as giving the victim "fresh air" or a "boost" to help them over the effects of an exposure.

It is now recognized that administering oxygen can be harmful if carried out improperly or in the wrong circumstances (1, 2). For example, oxygen in a concentration greater than 24% may stop breathing in victims with chronic obstructive pulmonary disease, such as chronic bronchitis or emphysema. As well, the presence of oxygen tanks in the workplace, can introduce additional hazards (1, 2). For example, oxygen feeds a fire or open flame. Therefore, it could contribute to a fire hazard in the workplace. Oxygen is stored under pressure. If the tank is punctured, or if the valve breaks, the tank can become a missile. Finally, oxygen, under high pressure, may explode in the presence of grease or oil.

There are, however, some situations for which the benefits of oxygen administration are unquestionable (3). These situations include chemical exposures which can cause:

- interference with the ability of oxygen to cross through the lungs to the blood stream, as in pulmonary edema,
- inadequate ability of blood to transport oxygen, as in severe anemia, methemoglobinemia, or carbon monoxide toxicity, or
- defective or compromised use of oxygen by body tissues, as in cyanide or sulfide toxicity.

In situations where administering oxygen is appropriate, first aiders must be trained in the safe use and handling of oxygen. It is preferable to administer oxygen with a doctor's supervision or advice.

3.2 Neutralization with Acids or Bases

At one time it was thought logical to neutralize exposure to an acid with a base or vice versa. Experience has shown that any attempt at neutralizing an ingested chemical or chemical contamination of the skin or eyes only increases the problem by causing:

- additional chemical injury with the introduction of a second harmful chemical; and
- thermal burns from the heat given off when the two chemicals react (5, 19).

Neutralization with acids or bases is not an appropriate first aid procedure for treatment of any chemical exposure.

3.3 Inducing Vomiting

Ingestion of a chemical is unlikely to occur in a workplace (6). Yet, whether or not to induce vomiting as a first aid measure for accidental ingestion of a chemical at work is a highly controversial subject.

Evidence and common sense indicate that inducing vomiting is not necessary for most occupational chemical ingestions.

Arguments against inducing vomiting follow.

The amount of chemical accidentally ingested by an adult is estimated to be very small (14-21 ml) (7). It does not seem sensible to use extreme measures to recover what is apt to be a small amount of chemical.

There is no conclusive evidence that victims of chemical ingestion who do have their stomachs emptied have more successful outcomes than victims who do not (8, 9).

There may be significant risks associated with inducing vomiting, especially in emergency situations. For example, vomiting may result in the inhalation of stomach contents (aspiration). The risk of aspiration depends on the physical properties of the chemical and/or the level of consciousness of the victim. Vomiting a corrosive could significantly increase damage to the mouth, throat and esophagus when the chemical contacts these sensitive tissues for a second time (5, 10). In an emergency it is not always possible to determine the nature of the chemical which has been ingested. The harm incurred by erroneously inducing vomiting for any of these chemicals would seem to outweigh any possible benefits.

There does not seem to be a reliable and safe first aid procedure for inducing vomiting in adults. For example, stimulation of the back of the throat with the finger, a spoon or some other blunt object often fails to induce vomiting. When it is successful, it rarely results in productive vomiting. In addition, this procedure may mechanically damage the back of the throat. Syrup of ipecac may not be as effective in adults as children and may take 15 to 30 minutes to work. During this time the victim's condition could deteriorate, increasing the risk of aspiration. Copper sulfate and salt water are poor inducers of vomiting and it is possible to give excessive, possibly toxic, doses of these materials. Rapid ingestion of a *large* volume of water is unreliable. If it does not induce vomiting, dilution of the ingested chemical with a large volume of water can enhance absorption through the stomach (6, 7, 10, 11, 12).

Medical attention is usually available quite quickly in most situations. Medical professionals can then determine if the stomach should be emptied and perform the procedure, if necessary. In light of these arguments, **the recommendation to induce vomiting should rarely be made for occupational chemical exposures. In fact, induction of vomiting should only be performed by first aiders when the chemical is very acutely toxic and medical follow-up is not readily available. In these cases, first aiders should receive special training on how to safely and effectively induce vomiting in the appropriate circumstances.**

3.4 Antidotes

It is a common misperception that antidotes are available for most chemical poisonings. True antidotes are the exception rather than the rule. Three commonly recommended antidotes are: the universal antidote, activated charcoal and milk. The validity of each of these antidotes is discussed below.

- The universal antidote is a mixture of tannic acid, magnesium oxide and activated charcoal. To quote one source, "There is not one iota of objective, controlled or quantitative evidence in its testimony (6)."
- Activated charcoal works by binding the chemical so it cannot be absorbed through the stomach. There has been a renewed interest in the use of activated charcoal in recent years. However, it is not considered as a recommended first aid procedure here. This is because it is necessary to swallow up to 10 times the weight of the ingested chemical to ensure success. This amount would be difficult to estimate and possibly difficult to ingest because of activated charcoals's gritty, unappealing texture and taste. In addition, the use of activated charcoal as a first aid measure could interfere with the effectiveness of syrup of ipecac. Syrup of ipecac may be the attending doctor's treatment of choice (7, 10, 12).
- Milk is sometimes recommended as antidote following an accidental chemical ingestion. It has been recommended because milk is thought to slow the absorption of some chemicals. This is true in some cases, but milk may also speed up the absorption of fat soluble chemicals. Evaporated milk is low in fat and may be useful in some circumstances, especially for corrosive ingestions. (6, 13, 14). However, milk, even evaporated milk, is unlikely to be readily available in a workplace.

Dilution of an ingested chemical with a small amount of water (240-300 mL) is the recommended procedure for most chemical ingestions. For corrosives,

dilution with a small amount of water (240-300 mL), followed by dilution with milk, if available, is the recommended procedure (14).

4. A STEP-BY-STEP-GUIDE TO MAKING RECOMMENDATIONS

This section presents a system for making appropriate, consistent first aid recommendations for MSDSs. First, the properties and health effects of products, which allow the selection of first aid recommendations, are identified. Then, a decision-making process is presented in flowcharts (decision trees), one for each route of exposure. Finally, use of the decision trees allows determination or evaluation of first aid recommendations for a specific product.

4.1 Information Needed to Make Recommendations

Before using this system, certain information about the chemical or product must be gathered. This information can be derived from the Physical Properties Section and each of the hazard identification sections: Fire and Explosion, Reactivity and Health. The specific information needed from each of these four areas and the reason for its inclusion is described below. Evaluation of a product's properties against criteria, such as those established in the Federal Controlled Products (WHMIS) regulations, can help answer some questions. If certain information for the product is not available, and a professional judgement cannot be made using information available for related products, it is prudent to make an assumption which will result in the most conservative first aid procedures. For example, if the flammablility of a product is unknown, assume the product is flammable. If the water solubility of a product is unknown, assume it is not water soluble. Both of these decisions will result in first aid recommendations conservative enough to alleviate any potential hazard. Table 1 is a worksheet which will assist in gathering the information required for making first aid decisions.

Physical Properties

IS THE PRODUCT USED AS A SOLID, LIQUID OR A GAS? This information helps determine which exposure routes and first aid measures are relevant for a particular product. For example, first aid for a solid particle in the eye may not be the same as first aid for a liquid in the eye.

IS THE PRODUCT SOLUBLE IN WATER? Products are water soluble if at least 1 gram of the product can dissolve in 1 litre of water (1 g/L). To make their removal easier, products which are not water soluble should be blotted or brushed from the skin, before flushing with water.

Reactivity Data

DOES THE PRODUCT REACT WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL? This information allows modification of the recommendation to reduce contact of the chemical with water, by blotting or brushing the chemical away, prior to flushing.

IS THE PRODUCT AN OXIDIZER? This information is needed so that contaminated clothing can be removed before it becomes a fire hazard. Oxidizers create a fire hazard by producing oxygen or another oxidizing substance.

Fire and Explosion Data

IS THE PRODUCT A FLAMMABLE LIQUID (CLOSED CUP FLASH POINT OF 37.8 DEG C (100 DEG F) OR LESS) OR A FLAMMABLE GAS? This information is required because the product could pose a significant fire hazard in an emergency situation. Recommendations should include warning the rescuer to take appropriate precautions, such as removing all sources of ignition. Also, the product must be removed from the exposed person.

Human Health

IS THE PRODUCT CAPABLE OF POSING AN IMMEDIATE AND SERIOUS THREAT TO THE RESCUER? A chemical poses an immediate and serious threat to the rescuer if it is a simple asphyxiant, or is very acutely toxic or corrosive. In any case, it is essential that the rescuer is protected when responding to the incident. Wherever possible advise the use of specific protective equipment, for example, butyl rubber gloves rather than "impervious" gloves.

IS THE PRODUCT CAPABLE OF POSING A SIGNIFICANT LONG-TERM HEALTH CONCERN FOR THE RESCUER? Although the chemical may not pose an immediate health risk, an expo-

sure may affect the health of the rescuer over the long term. This category includes chemicals which can cause cancer, birth defects or any other significant long term health effects. Again, it is imperative to protect the rescuers before they respond to the incident.

IS THE PRODUCT NON-IRRITATING, OR A MILD, MODERATE OR SEVERE IRRITANT? The degree of irritancy determines the amount of flushing required for skin or eye contact. For example, a mild irritant should need only 5 minutes of flushing with water. A moderate or severe irritant requires a minimum of 20 minutes of flushing to ensure complete removal of the product(15, 18). Note that corrosives require special first aid procedures and, therefore, irritancy is not relevant.

IS THE PRODUCT CORROSIVE? This information is required because corrosives require more prolonged flushing with water than irritants to ensure their complete removal. For skin or eye exposures, it is also important to know if a product is a penetrating or non-penetrating corrosive. Non-penetrating corrosives are chemicals which react with human tissue to form a protective layer which limits the extent of damage. Most acids are non-penetrating corrosives. Penetrating corrosives, for example most alkalies, hydrofluoric acid and phenol, enter the skin or eyes deeply. Penetrating corrosives require longer water flushing (a minimum of 60 minutes) than non-penetrating corrosives (a minimum of 20 to 30 minutes) (16, 18).

IS THE PRODUCT CAPABLE OF CAUSING PULMONARY EDEMA? Pulmonary edema is a life-threatening accumulation of fluid in the lungs. It interferes with the ability of oxygen to cross through the lungs into the body. Oxygen, as a first aid measure, may help victims who develop symptoms of pulmonary edema (3). Corrosive gases and severe irritants are examples of chemicals which can cause pulmonary edema.

IS THE PRODUCT CAPABLE OF CAUSING CENTRAL NERVOUS SYSTEM (CNS) DEPRESSION? Central nervous system depression can slow down or stop heart or lung function. If lung function is slowed down or stopped because of central nervous system depression, administering oxygen could worsen the symptoms (4). Therefore, only artificial respiration or cardiopulmonary resuscitation should be recommended.

IS THE PRODUCT CAPABLE OF INTERFERING WITH THE BODY'S ABILITY TO USE OXYGEN? As with pulmonary edema, this information is required to determine if oxygen is used. Two other ways in which chemicals can interfere with the body's use of oxygen are:

- by impairing oxygen transport in the blood, as with carbon monoxide, or
- by affecting use of oxygen in the cells, as with cyanide (3).

IS THE PRODUCT CAPABLE OF CAUSING SHORT-TERM TOXICITY AFFECTING BREATHING OR HEART FUNCTION? This information is important to determine if artificial respiration or cardiopulmonary resuscitation, and/or oxygen administration are required first aid measures.

IS THE PRODUCT LIKELY TO BE ASPIRATED OR IS THE PRODUCT CAPABLE OF CAUSING SERIOUS HEALTH EFFECTS IF ASPIRATED? The first group includes chemicals, such as certain hydrocarbons, which have low surface tension, low viscosity and the ability to attack lung tissue. These chemicals can be easily inhaled into the lungs during ingestion or vomiting. The second group of chemicals includes corrosives and severe irritants which, if inhaled during vomiting, could cause severe lung damage (17). This information is needed to determine if specific first aid measures should be recommended to reduce the risk of aspiration.

DOES THE PRODUCT HAVE LOW TOXICITY? This information is needed so the first aider can be advised that no health effects are expected and minimal precautionary measures can be taken. A chemical with low toxicity must be judged to cause neither significant short-term or long-term effects. Examples of chemicals with low toxicity are nuisance dusts and glycerol.

IS THE PRODUCT CAPABLE OF CAUSING TOXICITY TO THE FIRST AIDER THROUGH MOUTH-TO-MOUTH CONTACT? This information is needed because chemicals with high toxicity through skin contact could harm the rescuer. Therefore, mouth-to-mouth contact during artificial respiration or cardiopulmonary resuscitation should be avoided, unless appropriate mouth guards or shields are available.

IS THE PRODUCT CAPABLE OF CAUSING FROSTBITE OR FREEZING TISSUE? This information is needed to direct the first aider to follow special procedures such as not attempting to rewarm the affected area on site. Chemicals can cause frostbite or freeze tissue if they have a low boiling point (below 0 deg C (32 deg F)).

4.2 Decision Trees

Prior to using the decision trees, the information identified in Section 4.1 should be collected and summarized on the worksheet found below. The worksheet is then used to answer questions posed in the decision trees. This process will produce appropriate, consistent first aid recommendations for most workplace chemical products. Please note that several chemical exceptions have been identified to date. These exceptions are noted in Appendix 2 and should be reviewed before using the decision trees.

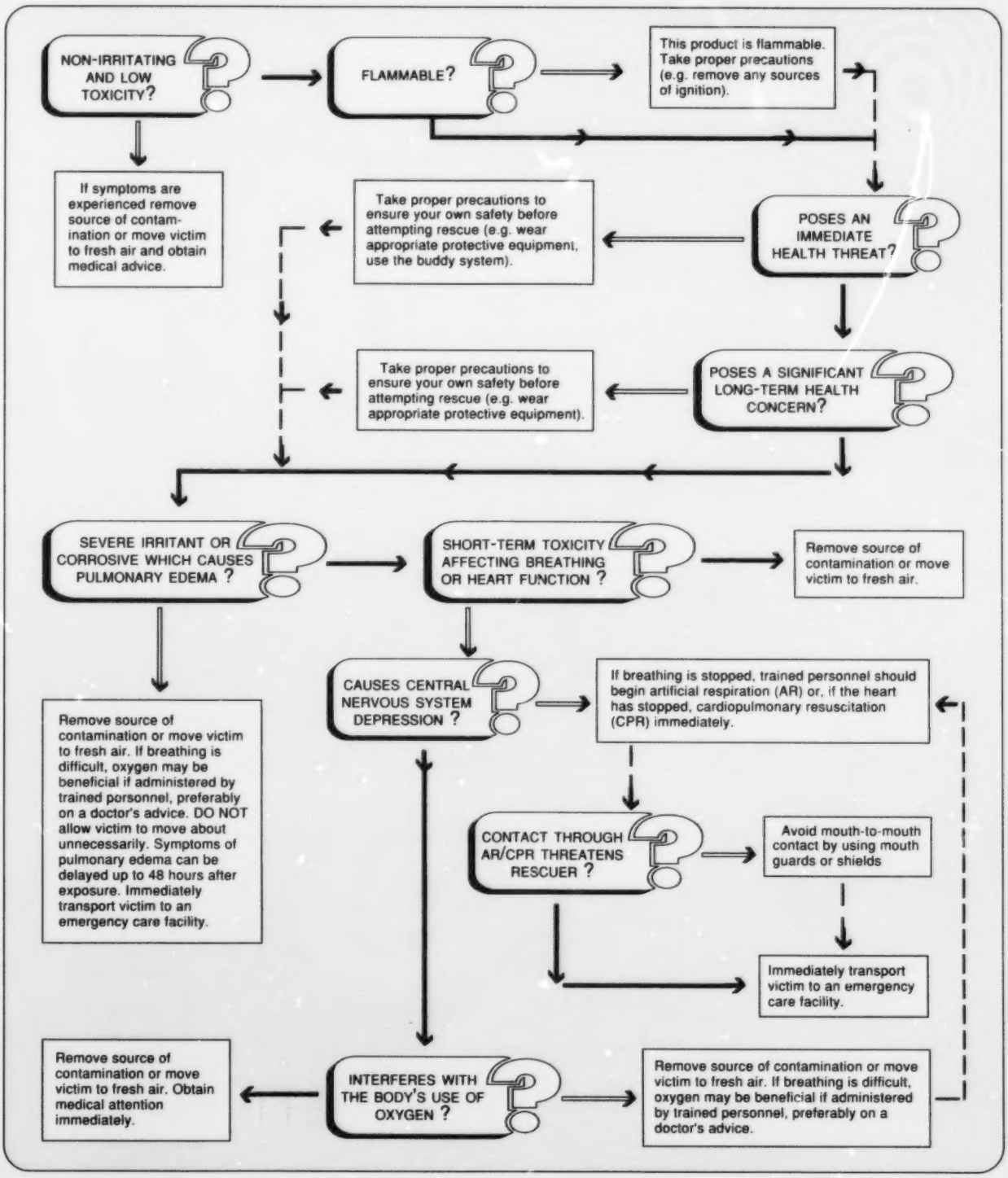
Decision Tree Worksheet

PHYSICAL STATE	GAS/LIQUID/SOLID
WATER SOLUBLE	*YES / NO**
REACTS WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL	*YES* / NO*
OXIDIZER	*YES* / NO*
FLAMMABLE	*YES* / NO*
DEGREE OF IRRITANCY	*NON-IRRITATING / MILD / MODERATE / SEVERE**
CORROSIVE	*YES* / NO* (penetrating corrosive*/ non-penetrating corrosive)
CAUSES PULMONARY EDEMA	*YES* / NO*
CAUSES CENTRAL NERVOUS SYSTEM (CNS) DEPRESSION	*YES* / NO*
INTERFERES WITH BODY'S USE OF OXYGEN	*YES* / NO*
SHORT-TERM TOXICITY AFFECTING BREATHING OR HEART FUNCTION	*YES* / NO*
SIGNIFICANT ASPIRATION THREAT	*YES* / NO*
POSES AN IMMEDIATE HEALTH THREAT TO RESCUER	*YES* / NO*
POSES A LONG-TERM HEALTH CONCERN TO RESCUER	*YES* / NO*
RISK OF TOXICITY TO RESCUER THROUGH AR/CPR	*YES* / NO*

** indicates the assumption which will result in the most conservative first aid recommendations*

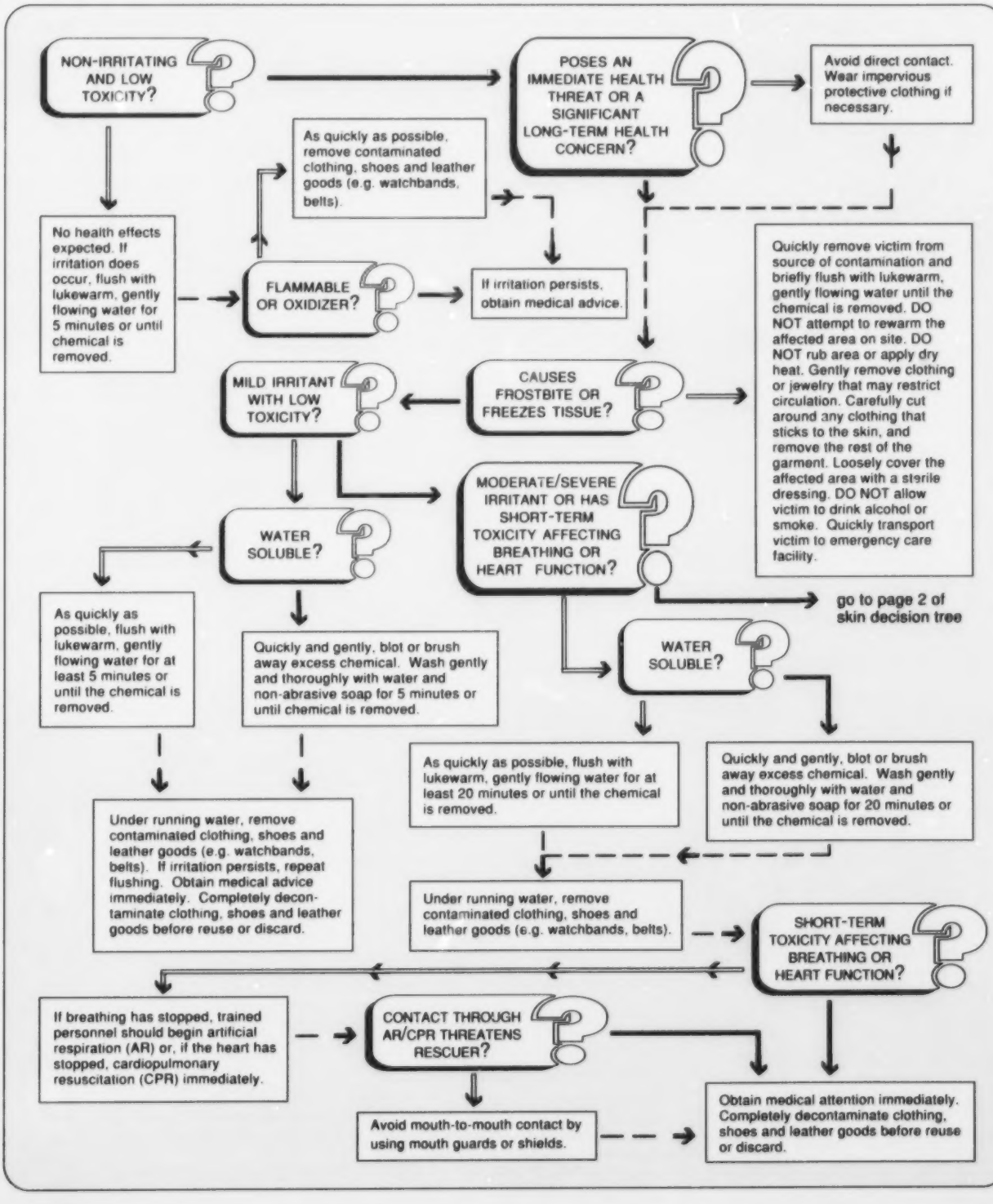
DECISION TREE FOR INHALATION EXPOSURE

Yes → **No** → **Continue** - - - - →


NON-IRRITATING AND LOW TOXICITY?
FLAMMABLE?
This product is flammable. Take proper precautions (e.g. remove any sources of ignition).
If symptoms are experienced remove source of contamination or move victim to fresh air and obtain medical advice.
Take proper precautions to ensure your own safety before attempting rescue (e.g. wear appropriate protective equipment, use the buddy system).
POSES AN IMMEDIATE HEALTH THREAT?
Take proper precautions to ensure your own safety before attempting rescue (e.g. wear appropriate protective equipment).
POSES A SIGNIFICANT LONG-TERM HEALTH CONCERN?
SEVERE IRRITANT OR CORROSIVE WHICH CAUSES PULMONARY EDEMA ?
SHORT-TERM TOXICITY AFFECTING BREATHING OR HEART FUNCTION ?
Remove source of contamination or move victim to fresh air.
Remove source of contamination or move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctor's advice. DO NOT allow victim to move about unnecessarily. Symptoms of pulmonary edema can be delayed up to 48 hours after exposure. Immediately transport victim to an emergency care facility.
CAUSES CENTRAL NERVOUS SYSTEM DEPRESSION ?
If breathing is stopped, trained personnel should begin artificial respiration (AR) or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately.
CONTACT THROUGH AR/CPR THREATENS RESCUER ?
Avoid mouth-to-mouth contact by using mouth guards or shields
Immediately transport victim to an emergency care facility.
Remove source of contamination or move victim to fresh air. Obtain medical attention immediately.
INTERFERES WITH THE BODY'S USE OF OXYGEN ?
Remove source of contamination or move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctor's advice.

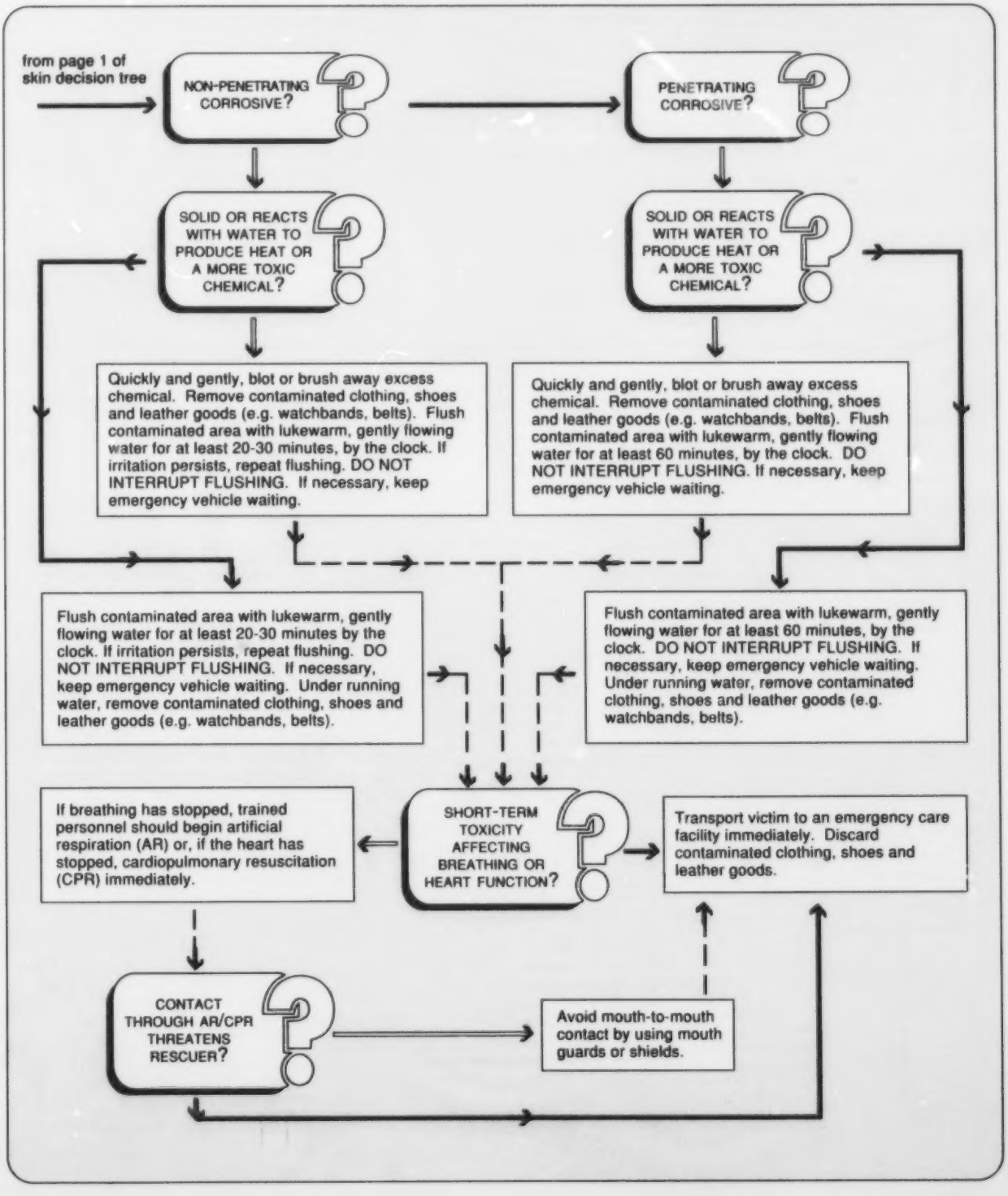
DECISION TREE FOR SKIN EXPOSURE

Yes → **No** → **Continue** - - - →


NON-IRRITATING AND LOW TOXICITY?
POSES AN IMMEDIATE HEALTH THREAT OR A SIGNIFICANT LONG-TERM HEALTH CONCERN?
Avoid direct contact. Wear impervious protective clothing if necessary.
As quickly as possible, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts).
No health effects expected. If irritation does occur, flush with lukewarm, gently flowing water for 5 minutes or until chemical is removed.
FLAMMABLE OR OXIDIZER?
If irritation persists, obtain medical advice.
Quickly remove victim from source of contamination and briefly flush with lukewarm, gently flowing water until the chemical is removed. DO NOT attempt to rewarm the affected area on site. DO NOT rub area or apply dry heat. Gently remove clothing or jewelry that may restrict circulation. Carefully cut around any clothing that sticks to the skin, and remove the rest of the garment. Loosely cover the affected area with a sterile dressing. DO NOT allow victim to drink alcohol or smoke. Quickly transport victim to emergency care facility.
CAUSES FROSTBITE OR FREEZES TISSUE?
MILD IRRITANT WITH LOW TOXICITY?
MODERATE/SEVERE IRRITANT OR HAS SHORT-TERM TOXICITY AFFECTING BREATHING OR HEART FUNCTION?
WATER SOLUBLE?
go to page 2 of skin decision tree
As quickly as possible, flush with lukewarm, gently flowing water for at least 5 minutes or until the chemical is removed.
Quickly and gently, blot or brush away excess chemical. Wash gently and thoroughly with water and non-abrasive soap for 5 minutes or until chemical is removed.
WATER SOLUBLE?
As quickly as possible, flush with lukewarm, gently flowing water for at least 20 minutes or until the chemical is removed.
Quickly and gently, blot or brush away excess chemical. Wash gently and thoroughly with water and non-abrasive soap for 20 minutes or until the chemical is removed.
Under running water, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts). If irritation persists, repeat flushing. Obtain medical advice immediately. Completely decontaminate clothing, shoes and leather goods before reuse or discard.
Under running water, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts).
SHORT-TERM TOXICITY AFFECTING BREATHING OR HEART FUNCTION?
If breathing has stopped, trained personnel should begin artificial respiration (AR) or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately.
CONTACT THROUGH AR/CPR THREATENS RESCUER?
Avoid mouth-to-mouth contact by using mouth guards or shields.
Obtain medical attention immediately. Completely decontaminate clothing, shoes and leather goods before reuse or discard.

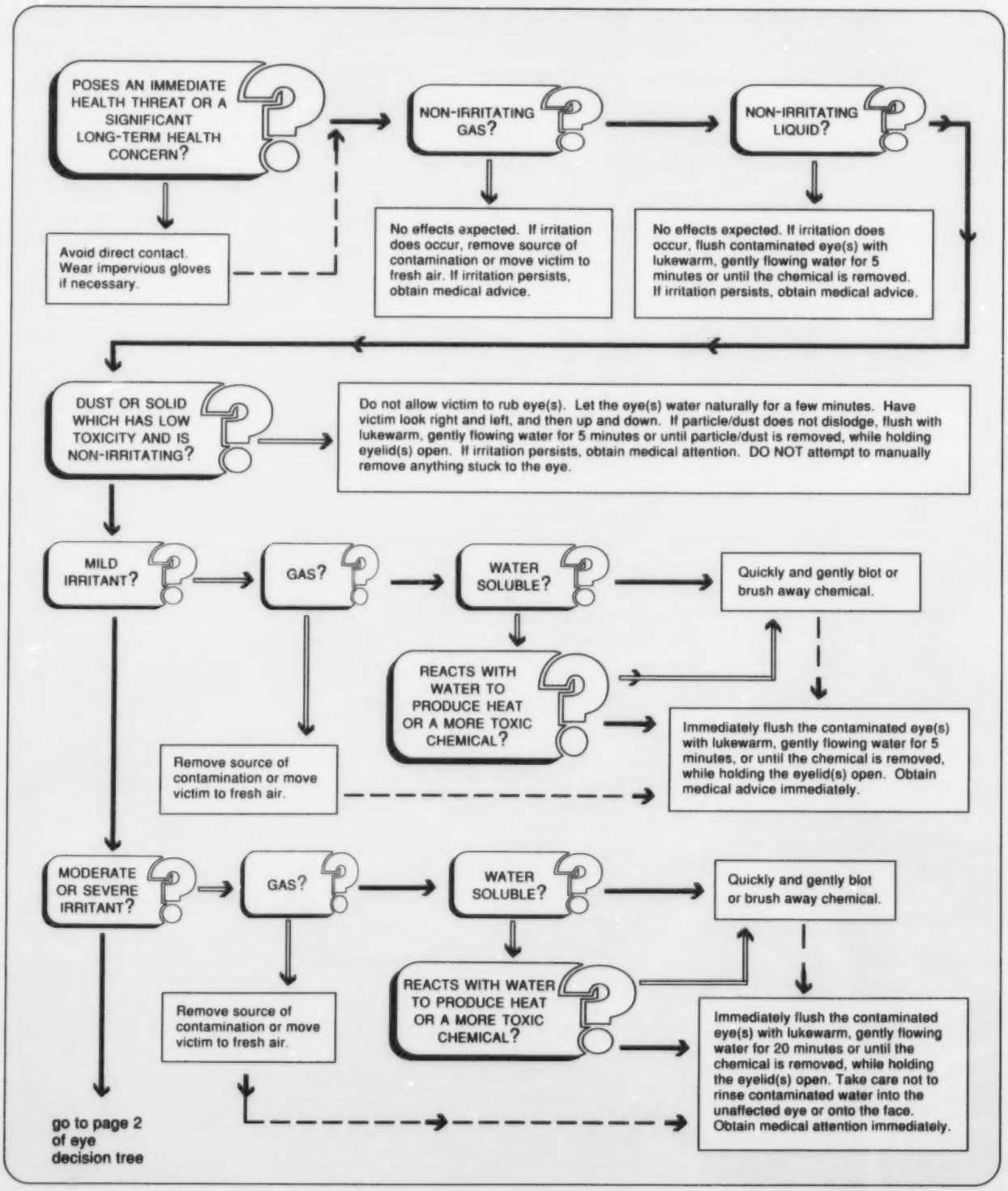
DECISION TREE FOR SKIN EXPOSURE

Yes → **No** → **Continue** - - - →


from page 1 of skin decision tree
NON-PENETRATING CORROSIVE?
PENETRATING CORROSIVE?
SOLID OR REACTS WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL?
SOLID OR REACTS WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL?
Quickly and gently, blot or brush away excess chemical. Remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Flush contaminated area with lukewarm, gently flowing water for at least 20-30 minutes, by the clock. If irritation persists, repeat flushing. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting.
Quickly and gently, blot or brush away excess chemical. Remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Flush contaminated area with lukewarm, gently flowing water for at least 60 minutes, by the clock. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting.
Flush contaminated area with lukewarm, gently flowing water for at least 20-30 minutes by the clock. If irritation persists, repeat flushing. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Under running water, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts).
Flush contaminated area with lukewarm, gently flowing water for at least 60 minutes, by the clock. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Under running water, remove contaminated clothing, shoes and leather goods (e.g. watchbands, belts).
If breathing has stopped, trained personnel should begin artificial respiration (AR) or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately.
SHORT-TERM TOXICITY AFFECTING BREATHING OR HEART FUNCTION?
Transport victim to an emergency care facility immediately. Discard contaminated clothing, shoes and leather goods.
CONTACT THROUGH AR/CPR THREATENS RESCUER?
Avoid mouth-to-mouth contact by using mouth guards or shields.

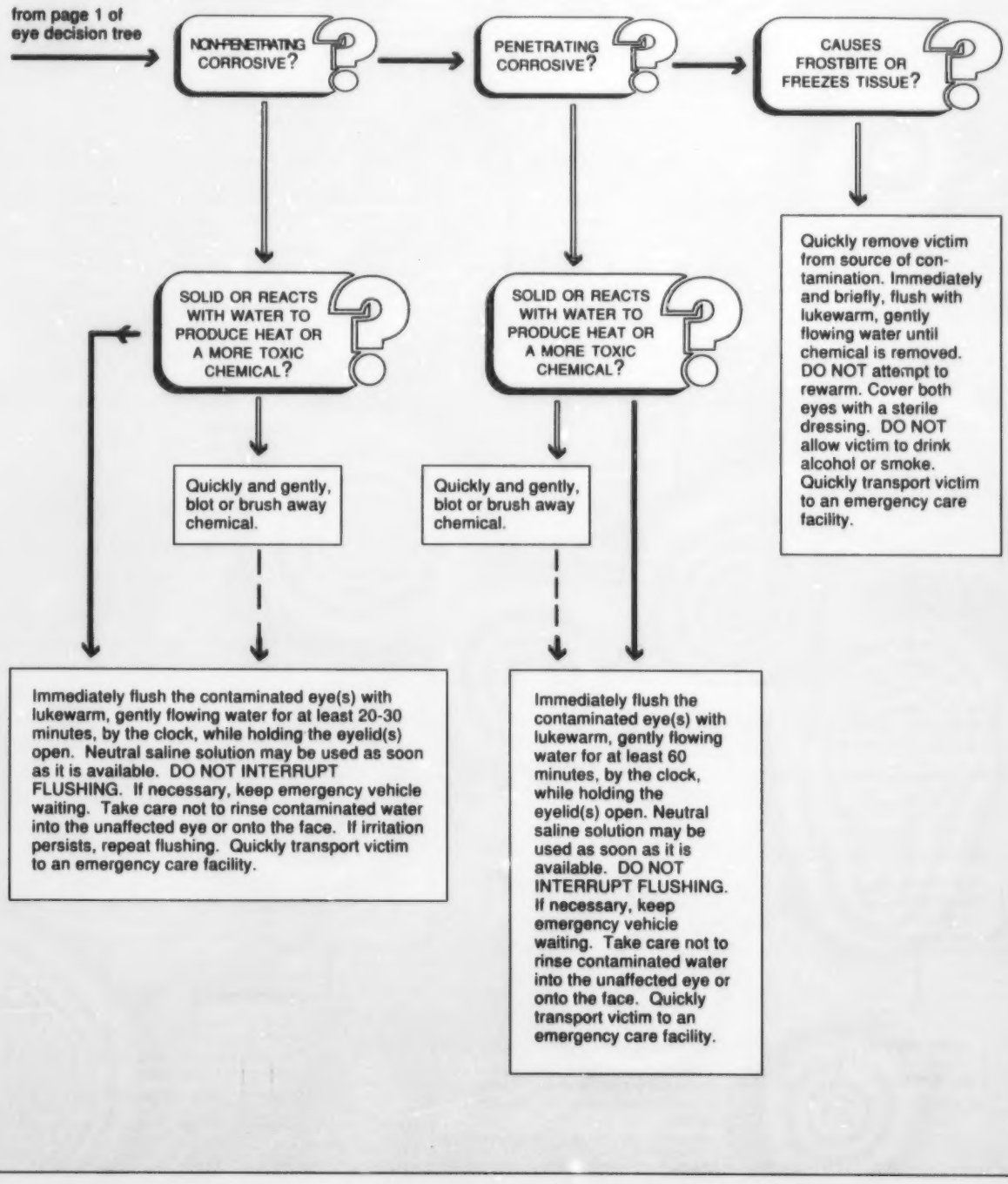
DECISION TREE FOR EYE EXPOSURE

Yes → *No* → *Continue* - - - - →


POSES AN IMMEDIATE HEALTH THREAT OR A SIGNIFICANT LONG-TERM HEALTH CONCERN?
Avoid direct contact. Wear impervious gloves if necessary.
NON-IRRITATING GAS?
No effects expected. If irritation does occur, remove source of contamination or move victim to fresh air. If irritation persists, obtain medical advice.
NON-IRRITATING LIQUID?
No effects expected. If irritation does occur, flush contaminated eye(s) with lukewarm, gently flowing water for 5 minutes or until the chemical is removed. If irritation persists, obtain medical advice.
DUST OR SOLID WHICH HAS LOW TOXICITY AND IS NON-IRRITATING?
Do not allow victim to rub eye(s). Let the eye(s) water naturally for a few minutes. Have victim look right and left, and then up and down. If particle/dust does not dislodge, flush with lukewarm, gently flowing water for 5 minutes or until particle/dust is removed, while holding eyelid(s) open. If irritation persists, obtain medical attention. DO NOT attempt to manually remove anything stuck to the eye.
MILD IRRITANT?
GAS?
WATER SOLUBLE?
Quickly and gently blot or brush away chemical.
REACTS WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL?
Remove source of contamination or move victim to fresh air.
Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for 5 minutes, or until the chemical is removed, while holding the eyelid(s) open. Obtain medical advice immediately.
MODERATE OR SEVERE IRRITANT?
GAS?
WATER SOLUBLE?
Quickly and gently blot or brush away chemical.
REACTS WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL?
Remove source of contamination or move victim to fresh air.
Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for 20 minutes or until the chemical is removed, while holding the eyelid(s) open. Take care not to rinse contaminated water into the unaffected eye or onto the face. Obtain medical attention immediately.
go to page 2 of eye decision tree

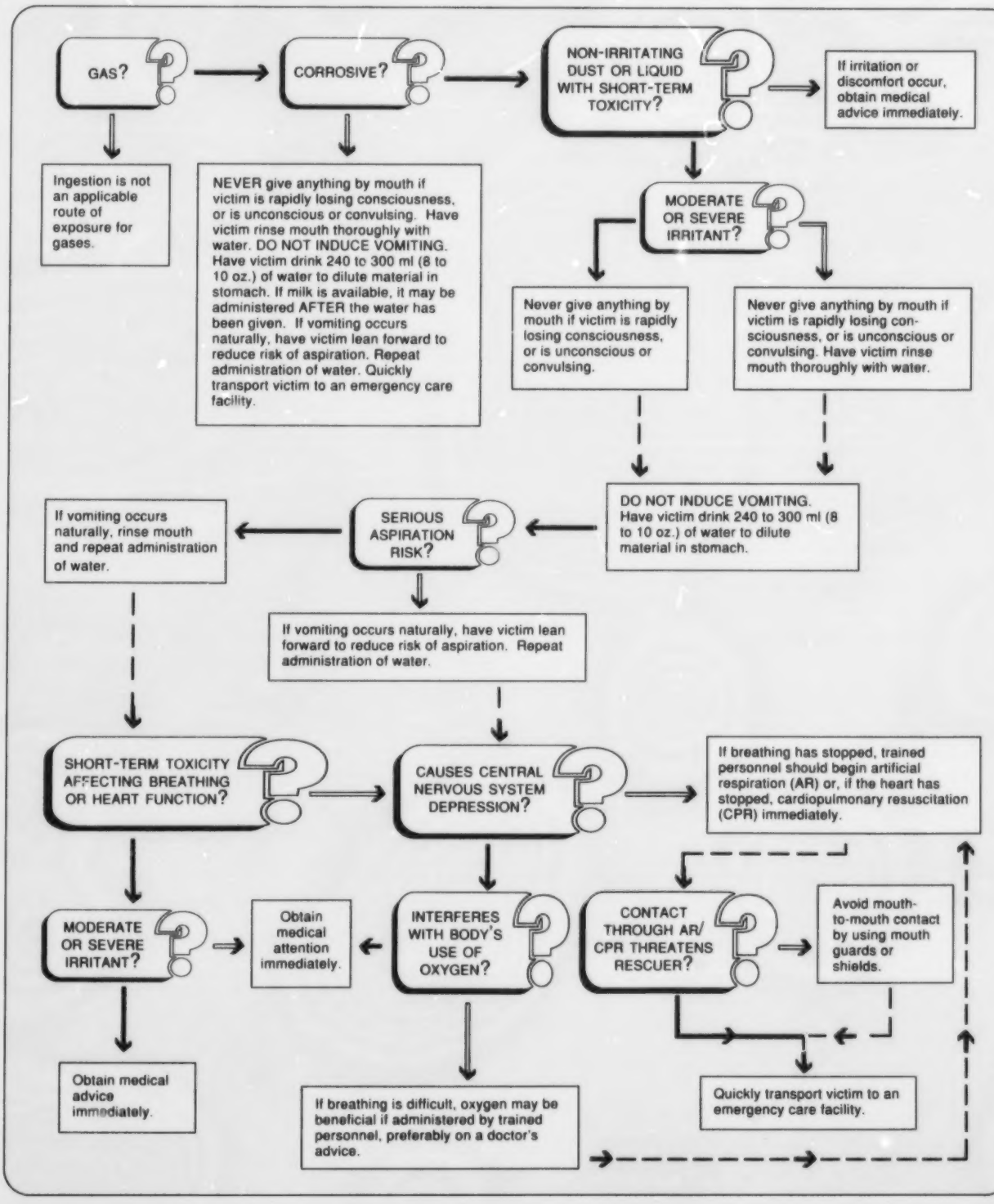
DECISION TREE FOR EYE EXPOSURE

Yes ⟹ *No* ⟶ *Continue* - - - - →


from page 1 of eye decision tree
NON-PENETRATING CORROSIVE?
PENETRATING CORROSIVE?
CAUSES FROSTBITE OR FREEZES TISSUE?
SOLID OR REACTS WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL?
SOLID OR REACTS WITH WATER TO PRODUCE HEAT OR A MORE TOXIC CHEMICAL?
Quickly remove victim from source of contamination. Immediately and briefly, flush with lukewarm, gently flowing water until chemical is removed. DO NOT attempt to rewarm. Cover both eyes with a sterile dressing. DO NOT allow victim to drink alcohol or smoke. Quickly transport victim to an emergency care facility.
Quickly and gently, blot or brush away chemical.
Quickly and gently, blot or brush away chemical.
Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 20-30 minutes, by the clock, while holding the eyelid(s) open. Neutral saline solution may be used as soon as it is available. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Take care not to rinse contaminated water into the unaffected eye or onto the face. If irritation persists, repeat flushing. Quickly transport victim to an emergency care facility.
Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 60 minutes, by the clock, while holding the eyelid(s) open. Neutral saline solution may be used as soon as it is available. DO NOT INTERRUPT FLUSHING. If necessary, keep emergency vehicle waiting. Take care not to rinse contaminated water into the unaffected eye or onto the face. Quickly transport victim to an emergency care facility.

DECISION TREE FOR INGESTION EXPOSURE

Yes → **No** → **Continue** - - - - →


GAS?
CORROSIVE?
NON-IRRITATING DUST OR LIQUID WITH SHORT-TERM TOXICITY?
If irritation or discomfort occur, obtain medical advice immediately.
Ingestion is not an applicable route of exposure for gases.
NEVER give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. Have victim rinse mouth thoroughly with water. DO NOT INDUCE VOMITING. Have victim drink 240 to 300 ml (8 to 10 oz.) of water to dilute material in stomach. If milk is available, it may be administered AFTER the water has been given. If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Repeat administration of water. Quickly transport victim to an emergency care facility.
MODERATE OR SEVERE IRRITANT?
Never give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing.
Never give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. Have victim rinse mouth thoroughly with water.
DO NOT INDUCE VOMITING. Have victim drink 240 to 300 ml (8 to 10 oz.) of water to dilute material in stomach.
SERIOUS ASPIRATION RISK?
If vomiting occurs naturally, rinse mouth and repeat administration of water.
If vomiting occurs naturally, have victim lean forward to reduce risk of aspiration. Repeat administration of water.
SHORT-TERM TOXICITY AFFECTING BREATHING OR HEART FUNCTION?
CAUSES CENTRAL NERVOUS SYSTEM DEPRESSION?
If breathing has stopped, trained personnel should begin artificial respiration (AR) or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately.
MODERATE OR SEVERE IRRITANT?
Obtain medical attention immediately.
INTERFERES WITH BODY'S USE OF OXYGEN?
CONTACT THROUGH AR/ CPR THREATENS RESCUER?
Avoid mouth-to-mouth contact by using mouth guards or shields.
Obtain medical advice immediately.
If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctor's advice.
Quickly transport victim to an emergency care facility.

5. CONCLUSION

This document provides a framework for preparing appropriate and consistent first aid recommendations for Material Safety Data Sheets. Examples of recommendations resulting from application of this system are presented in Appendix 1. Once the decision trees have been used for a specific product, the resulting recommendations should be carefully evaluated. This evaluation should be based on the MSDS writer or reviewer's specific knowledge of the chemical and how it is used, and the first aid principles described in Section 2. This process will help ensure that well-balanced, appropriate recommendations have been derived.

It may be necessary to customize first aid recommendations based on situational factors. The MSDS is only a starting point for developing a good specific worksite first aid program. A doctor familiar with the product, its use, the work environment and the community medical facilities should evaluate all first aid procedures. In addition, remember that each emergency situation is unique. It is imperative that the first aider be trained to exercise good judgment before carrying out any first aid procedure.

Anyone who might be called upon to give first aid in an emergency should become familiar with the recommended first aid before working with the product. It is impossible to overemphasize the importance of being prepared. Within each jurisdiction, first aid training requirements vary. However, every potential first aider should have the minimal training necessary to use any first aid procedure required for an exposure to products present in the workplace. First aiders should never try to perform a procedure which is beyond their own expertise. If there is any doubt about the appropriateness of any first aid procedure during an emergency, the nearest Poison Control Centre should be called and their advice followed.

NOTES

APPENDIX 1 - EXAMPLES OF APPLICATIONS

Skin Contact with Methyl Iodide

Information Needed to Make Recommendations	*Suggested Phrasing*
• poses a significant long-term health concern	Avoid direct contact. Wear impervious protective clothing if necessary.
• water soluble • moderate to severe irritant	As quickly as possible, flush with lukewarm, gently flowing water for at least 20 minutes or until chemical is removed. Under running water remove contaminated clothing, shoes and leather goods (e.g watchbands, belts).
• has short-term toxicity affecting breathing or the heart	If breathing has stopped, trained personnel should begin artificial respiration (AR) or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately.
• contact through AR/CPR threaten rescuer	Avoid mouth-to-mouth contact by using mouth guards or shields. Obtain medical attention immediately. Completely decontaminate clothing, shoes and leather goods.

Eye Contact with Sugar

Information Needed to Make Recommendations	*Suggested Phrasing*
• solid • low toxicity • non-irritating	Do not allow victim to rub eye(s). Let the eye(s) water naturally for a few minutes. Have victim look right and left, and then up an down. If particle/dust does not dislodge, flush with lukewarm, gently flowing water for five minutes or until particle/dust is removed, while holding eyelid(s) open. If irritation persists, obtain medical attention. DO NOT attempt to manually remove anything stuck to eye.

Inhalation of Lithium Hydroxide

Information Needed to Make Recommendations	*Suggested Phrasing*
• poses immediate serious health threat	Take proper precautions to ensure your own safety before attempting rescue (e.g., wear appropriate protective equipment, use the buddy system).
• corrosive • causes pulmonary edema	Remove source of contamination or move victim to fresh air. If breathing is difficult, oxygen may be beneficial if administered by trained personnel, preferably on a doctors's advice. DO NOT allow the victim to move about unnecessarily. Symptoms of pulmonary edema can be de layed up to 48 hours after exposure. Immediately transport victim to an emergency care facility.

APPENDIX 2 - EXCEPTIONS TO DECISION TREES

Chemical	*Route of Exposure*	*Suggested Recommendations*
Cyanide compounds with cyanide ion toxicity. Sulfide compounds.	Inhalation Skin contact (for skin absorbed compounds) Ingestion	Amyl nitrite is an accepted antidote for cyanide and sulfide compounds. Only first aiders with appropriate training should administer amyl nitrite Recommendations should advise the administration of oxygen for significant skin/ingestion exposures since cyanide and sulfide chemicals can interfere with respiration (28).
Metals which can cause metal fume fever. Plastic polymers which can cause polymer fume fever.	Inhalation	These chemicals can cause a completely reversible flu-like illness up to 24 hours after exposure. Recommendations should advise exposed persons to obtain medical attention if flu-like symptoms develop within 24 hours after exposure.
Highly volatile chemicals which quickly form high local vapour concentrations and pose a significant inhalation hazard. For example, carbon disulfide and isocyanates.	Skin contact	Recommendations for skin should refer to the inhalation health effects and inhalation first aid recommendations.
Hydrofluoric acid Fluoride compounds	Skin contact Eye contact Ingestion Inhalation	These chemicals can cause severe corrosive burns which require more extensive first aid than other acid burns. Certain ointments have proven beneficial in first aid. Therefore, recommendations should advise flushing the contaminated area with lukewarm, gently flowing water for 5 minutes for skin contact or 15 minutes for eye contact. Then use: iced 0.2% water solution (1:500) hyamine 1622 (Rohm & Haas) or iced 0.13% Zephiran (Winthrop Laboratories) for skin contact; 2.5% calcium gluconate for sensitive tissues, such as lips; 0.5% pontocaine hydrochloride (Winthrop Laboratories) for eyes; 10% calcium gluconate for ingestion (27). If the ointments are not available, continue flushing contaminated skin with lukewarm, gently flowing water until the ointments can be applied.

Chemical	*Route of Exposure*	*Suggested Recommendations*
Phenol Phenol derivatives which are corrosive and have phenol toxicity.	Skin Contact	Dilution of phenol and some phenol compounds with water can enhance skin absorption. Therefore, recommendations should advise the use of a polyethylene glycol 300 or 400 solution or PEG/MS mixture (polyethylene glycol/methylated spirits in a 2:1 ratio), as soon as it is available, to remove phenol. Recommendations should not advise the use of the PEG/MS mixture on the eyes or around the mouth (20). Also, recommendations should stress that water flushing not be delayed if the PEG/MS is not immediately available, since many of these compounds are also corrosive.
Solid materials which could splinter and penetrate the skin or eye(s).	Skin contact Eye contact	Splinters could lodge in the skin/eye(s). Recommendations should advise not to remove the splinter since further damage could result. First aiders should cover the wound with a sterile dressing and transport the victim to an emergency aid facility. If the eye has been penetrated, first aiders should cover both eyes and transport the victim on a stretcher to reduce eye movement which could aggravate the injury (21).
Metals such as lithium, sodium and potassium.	Skin contact	These metals ignite upon contact with moisture. Recommendations should advise extinguishing flames with Class D fire extinguisher. Then, the first aider should coat the affected area with a non-toxic oil such as mineral oil or cooking oil, before transporting the victim to an emergency care facility (16, 22).
White phosphorus	Skin contact	White phosphorus ignites upon contact with air at 34 deg C (93 deg F). Recommendations should advise first aiders to submerse the affected body part in cool water, since warm water 44 deg C (111 deg F) promotes conversion to phosphoric acid. They should then cover the affected area with towels soaked in cool water and transport the victim to an emergency care facility (19, 22).

*NOTE: If additional exceptions are identified, please inform CCOHS so the decision tree system can be refined.

APPENDIX 3

EXPLANATION OF SPECIFIC WORDING USED IN FIRST AID RECOMMENDATIONS

"by the clock" The duration of rinsing is important. Seconds may seem like minutes during an emergency.

"DO NOT allow victim to drink alcohol or smoke." The supply of blood to frozen tissue is already constricted. Consumption of alcohol or smoking may further constrict the blood supply and intensify damage.

"DO NOT allow victim to move about unnecessarily" Unnecessary physical exertion could aggravate the effects of pulmonary edema.

"DO NOT allow victim to rub the affected eye(s)." This is a natural response to an eye irritant which could cause additional abrasion of the eye.

"DO NOT attempt to manually remove anything stuck to eye." Efforts to remove a foreign body adhering to the eye could cause penetration or abrasion.

"DO NOT attempt to rewarm the affected area on site." Rewarming frozen tissue is a complex process which requires experienced medical care. The speed of rewarming must be carefully controlled, as should the temperature. There is also a high risk of infection. Finally, medical control of intense pain may be necessary. (23, 24, 25, 26).

"DO NOT interrupt flushing" This phrase stresses the importance of prolonged flushing with water.

"DO NOT rub area or apply dry heat." Frozen tissue is very sensitive and rubbing or application of dry heat could intensify damage.

"gently flowing" A fast stream of water could cause the product to splash, harming the first aider. In addition, a force of water could add mechanical damage to injured skin or eye(s).

"holding the eyelid(s) open" Pain causes forced closing of the eyelids. Therefore, help is necessary to keep the eyelid(s) open to ensure a thorough flushing of the eye and eyelid.

"immediately" The speed with which first aid should begin cannot be stressed enough. For example, beginning water flushing within one minute is more effective in reducing injury than beginning water flushing within three minutes (19).

"lukewarm water" The water temperature should be approximately 37 deg C (98.6 deg F). This is because the victim may not tolerate extended flushing with cold or hot water, and untempered water may cause further damage.

"medical advice" The victim does not necessarily need medical attention. However, a medical professional should be verbally consulted to determine if follow-up is required.

"medical attention" A medical professional must see the victim to determine if medical treatment is necessary.

"never give anything by mouth to a victim who is rapidly losing consciousness, is unconscious or convulsing." These conditions increase the risk of aspiration (7, 10).

"non-abrasive soap" A harsh soap or detergent could further aggravate a chemical skin injury.

"preferably on a doctor's advice" There are individual factors which may affect the safety of the procedure. If possible, a doctor should weigh these factors and decide upon the appropriateness of the procedure under the specific circumstances.

"quickly transport victim to an emergency care facility immediately" It is urgent to transport the victim to an emergency care facility after performing any first aid measures needed to stabilize his/her condition.

"trained personnel" Training beyond basic first aid may be required to perform the procedure safely and effectively. Requirements for advanced training vary between jurisdictions.

"water" The use of water serves three purposes:

- it dilutes the product, reducing exposure (19),
- it removes the product from the skin/eye(s) (19),
- it cools any heat generated by reaction of the product with water or tissue (22).

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